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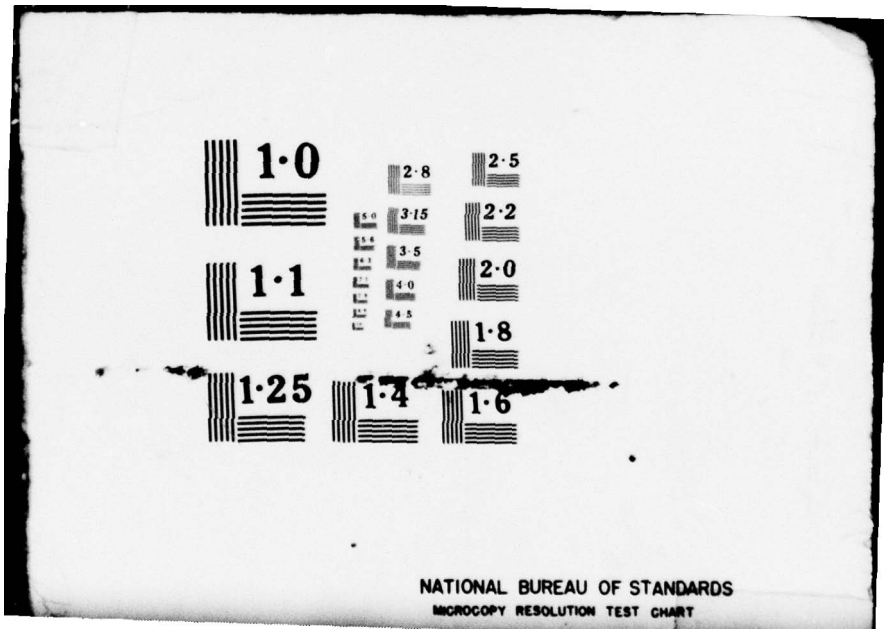
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EVALUATING THE ABILITY OF THE MAINTENANCE DATA COLLECTION SYSTEM TO ENHANCE THE AIR FORCE MUNITIONS PRODUCT ASSURANCE PROGRAM

Michael C. Cox, Captain, USAF
James W. O'Neal, Captain, USAF

LSSR 9-79A

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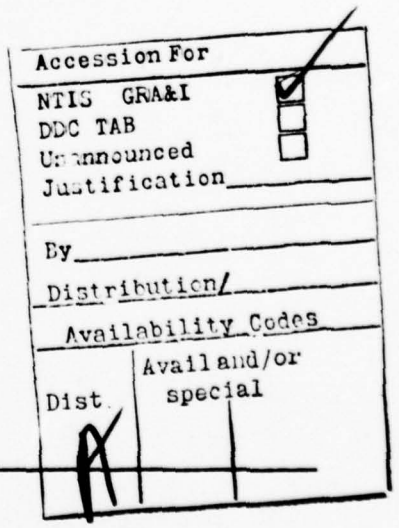

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: AFIT-LSSR-9-79A	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): EVALUATING THE ABILITY OF THE MAINTENANCE DATA COLLECTION SYSTEM TO ENHANCE THE AIR FORCE MUNITIONS PRODUCT ASSURANCE PROGRAM,	5. TYPE OF REPORT & PERIOD COVERED: Master's Thesis
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Michael C. Cox, Captain, USAF James W. O'Neal, Captain, USAF	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Graduate Education Division School of Systems and Logistics Air Force Institute of Technology, WPAFB OH	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 12 66p.
11. CONTROLLING OFFICE NAME AND ADDRESS: Department of Research and Administrative Management AFIT/LSGR, WPAFB OH 45433	12. REPORT DATE: June 1979 13. NUMBER OF PAGES: 55
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

JOSEPH P. HIPPS, Major, USAF
Director of Information

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DO56
MAINTENANCE DATA COLLECTION
MUNITIONS
PRODUCT ASSURANCE PROGRAM
MANAGEMENT INFORMATION SYSTEM

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Thesis Chairman: Donald R. Edwards, Lieutenant Colonel, USAF

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UNCLASSIFIED D17-250

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

The Air Force munitions community is tasked by AFR 74-9 to maintain a product assurance program for munitions items. Presently, the DO56 Maintenance Data Collection System (MDC) used by munitions personnel has failed to provide the necessary information to maintain an Air Force product assurance program for munitions. This study determined what information is needed by the munitions community concerning the munitions maintenance activities at the unit level. This research concluded that MDC does supply useful information in this area. Problem areas dealing with code uses and lack of specific guidance are addressed and recommended solutions are made. An active Munitions Product Assurance Program requires the data supplied by the Maintenance Data Collection system.

LSSR 9-79A

EVALUATING THE ABILITY OF THE MAINTENANCE DATA COLLECTION SYSTEM TO ENHANCE THE AIR FORCE MUNITIONS PRODUCT ASSURANCE PROGRAM

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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Captain, USAF

June 1979

This thesis, written by

Captain Michael C. Cox

and

Captain James W. O'Neal

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degrees of

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT
(Captain Michael C. Cox)

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT
(ACQUISITION LOGISTICS MAJOR)
(Captain James W. O'Neal)

DATE: 13 June 1979

Donald R Edwards
COMMITTEE CHAIRMAN

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CHAPTER I

INTRODUCTION

Problem Statement

The Air Force munitions community is tasked by AFR 74-9 to maintain a Product Assurance Program for munitions items and their related components. The product assurance information is documented manually, keypunched, and submitted to computers for storage and manipulation. The DO56 Maintenance Data Collection System (MDC) is presently failing to provide the information necessary to maintain an Air Force product assurance program for munitions. Related Air Force Inspector General reports indicate the product assurance program has in fact deteriorated due to inadequate information (10).

Justification

AFR 74-9, Nonnuclear Munitions Product Assurance Program,[1] establishes policy, assigns responsibility, and defines the objectives of the Air Force Nonnuclear Munitions Product Assurance Program. The regulation tasks Air Force Logistics Command (AFLC) to perform several product

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[1]Within the Air Force munitions community the terms "quality assurance" and "product assurance" are synonymous. In this study we will use the term "product assurance."

assurance functions. Two significant functions, data analysis and deficiency prevention/detection, depend upon data inputs from field level munitions maintenance activities through the DO56 MDC system (16:1). HQ AFLC has established the Ogden Air Logistics Center (OO-ALC) as the single point manager for all nonnuclear munitions activities. Maintenance data collected under the DO56 MDC system is not being used by the Ogden Air Logistics Center (OO-ALC) or HQ AFLC to promote the Air Force Product Assurance Program for munitions. This deficiency was noted in the June 1978 Air Force Inspector General report which stated,

> We found that nonnuclear munitions maintenance data from field units were being forwarded to AFLC. These data were then made available to the AFLC community; however, it was available only on demand. We were not able to document any demands for this MDC. As a result, AF field units are spending time and monies inputting data into a system from which no benefits are gained. The MDC program is currently not a part of the quality assurance program for nonnuclear munitions [10:3-1].

Research Objectives

There are three objectives identified with this study:

1. Identify the munitions product performance information generated by unit level munitions technicians that is necessary to support the Nonnuclear Munitions Product Assurance Program.

2. Evaluate the present DO56 MDC system as it relates to the Nonnuclear Munitions Product Assurance Program.

3. Provide guidance to the munitions community which will enable the present DO56 system to better supply the information needed for a Munitions Product Assurance Program.

Research Questions

1. What product performance factors should be investigated by the munitions technician at OO-ALC to insure a product assurance program?

2. Does the current DO56 MDC system provide the information necessary to evaluate the product performance factors needed for a product assurance program?

3. Can the present DO56 MDC system be modified to provide the information necessary to enhance the munitions product assurance program?

Organization of the Study

The initial step toward fulfilling the stated research objectives was to identify the product performance critical values used by the OO-ALC munitions technicians. These critical values influence the decision-making process used by the Ogden Air Logistics Center with regard to the Air Force Munitions Product Assurance Program. Chapter II traces a short history and evolution of the DO56 MDC system.

Additionally, management information system designing principles and decision-making structures are presented. Chapter III describes the basic methodology to be used to identify performance factors, evaluate the ability of the current DO56 to provide information on those factors, and to develop a method of analyzing and presenting the data which will aid the munitions community in conducting the required Product Assurance Program. Chapter IV evaluates the ability of the DO56 system to enhance the munitions Product Assurance Program. Recommendations and conclusions based on the findings derived from this study are presented in Chapter V.

CHAPTER II

BACKGROUND AND DEVELOPMENT

This chapter is designed to provide a better understanding of the current environment surrounding the munitions portion of the DO56 Maintenance Data Collection System (MDC). This design includes a short historical development on the evolution of the current DO56; an overview of present munitions procedures that impact the data-gathering process within the munitions community; a look at the importance of information; the definition of a system; the construction of an information system; and finally, a review of current criticisms of information systems focusing specifically upon the DO56 MDC.

MDC--A Short History

The present MDC system is an evolving system and yet its policy has changed very little from the first AFM 66-1, dated June 1955. The original MDC system was to provide:

1. Production Credit. An accounting process of the number of work units accomplished.

2. Exception Time Accounting (ETA). Recording manhour utilization.

3. Maintenance Data Collection (MDC). An accounting of product performance. This MDC was to replace the "Unsatisfactory Report" system used by the Logistics Command (1:5).

The use of the first MDC remained optional until 1958. AFM 66-1 was then revised to require 100 percent reporting of ETA and MDC data. The production credit information was retained only at the depot level where the environment was appropriate for using the production credit reporting system. The Air Logistics Centers (ALC) are still using the production credit reporting system today (1:6).

During 1959-1960, the reporting of maintenance data received ever-increasing emphasis. This emphasis was based on the belief that the MDC data contained significant gaps, and the field level units began receiving additional pressure for accurate, 100 percent reporting. The MDC training focused on the reporting procedures and not on how the information could be used (1:7).

Exception Time Accounting (ETA) proved to be an administrative "nightmare" as a result of the requirements for the voluminous accumulation of data. As a result, ETA became optional in 1965. Only the Maintenance Data Collection portion of the original system remained. It is still in existence today (1:8).

The inclusion of the munitions information into the DO56 MDC occurred during 1972-1973. There was no attempt to modify the ongoing system to accept the munitions data. Rather, it was the munitions data that were modified to fit the system. Thus the original designers of the DO56 never envisioned the incorporation of munitions data.

The munitions community continues to be skeptical of the MDC system regarding the ability of the system to define what is actually occurring in munitions. Air Force munitions maintenance personnel rely heavily on manual data systems such as the Ammunition Disposition Reports (ADR) (2).

A better understanding of the ADR system and its relation to the DO56 MDC can be obtained by looking at the munitions data-gathering process that supplies data to both systems.

Generating Munitions Data

Munitions data for the DO56 system originates from unit level Air Force munition maintenance activities. These activities are tasked with the responsibility for inspection and maintenance of the munitions items under their control (15:7-14).

The various Air Force munitions technical orders and manuals outline these responsibilities in detail.

Through compliance with these publications, the unit level munitions maintenance technician conducts inspections and performs various functional tests. The inspections and tests indicate the serviceability status to the unit level munitions technician. For example, a unit could have .38 caliber bullets in its inventory. Munitions cycle inventories are not conducted on the entire stockpile but on a sized sample. The technical order for .38 caliber ammunition states that a sized sample of the inventory will consist of 6.25 percent of the total stock of .38 caliber ammunition on hand. If 5 percent of the sample taken contains a defect, then a 100 percent inspection is required, and the results are to be reported (7:4). If the unit has 2000 rounds of .38 caliber ammunition on hand the sample size would be 125 units. During the course of the regular inspection if more than six bullets were found to be defective the technician would then inspect all 2000 and report his findings. The results of the above example inspection would be reported through two reporting channels. First, the D056 Maintenance Data Collection system is used to report the inspection through the use of an Air Force Form 349, Maintenance Data Collection Record. An AF Form 349 is created by munitions control and completed by the munitions technician for each maintenance action taken. The AF Form 349 documents the task assigned, the anticipated number of maintenance manhours required to perform the task, the

actual number of manhours expended against the task, task results, and recommendations. For a cycle inspection a separate AF Form 349 would be generated to (1) remove the .38 caliber munitions from storage for inspection, (2) perform the inspection, (3) return the serviceable munitions to storage, and (4) dispose of unserviceable munitions as necessary (15:8).

The data compiled from the completed AF Form 349s are then loaded into the unit level maintenance computer system (generally the Burrows 3500). These data, once loaded, become a part of the D056 MDC system and are transmitted directly to HQ AFLC (Figure 1). The AF Form 349 munitions data are compiled at HQ AFLC and are presently stored on magnetic tape in a historical file.

The second reporting channel is referred to as the Ammunition Disposition Request (ADR) system. The ADR exception reporting system originates when a munitions item has been identified as unserviceable in accordance with specific munitions item technical orders (14:3). If during an inspection or a functional check of an item the unit technician finds a munitions item to be unserviceable, as specified in the technical order, he would fill out an Air Force Form 191, Ammunition Disposition Request (ADR). A primary consideration in filling out the ADR is the dollar value of the items involved. In the case of .38 caliber ammunition, a munitions technician would not submit an ADR

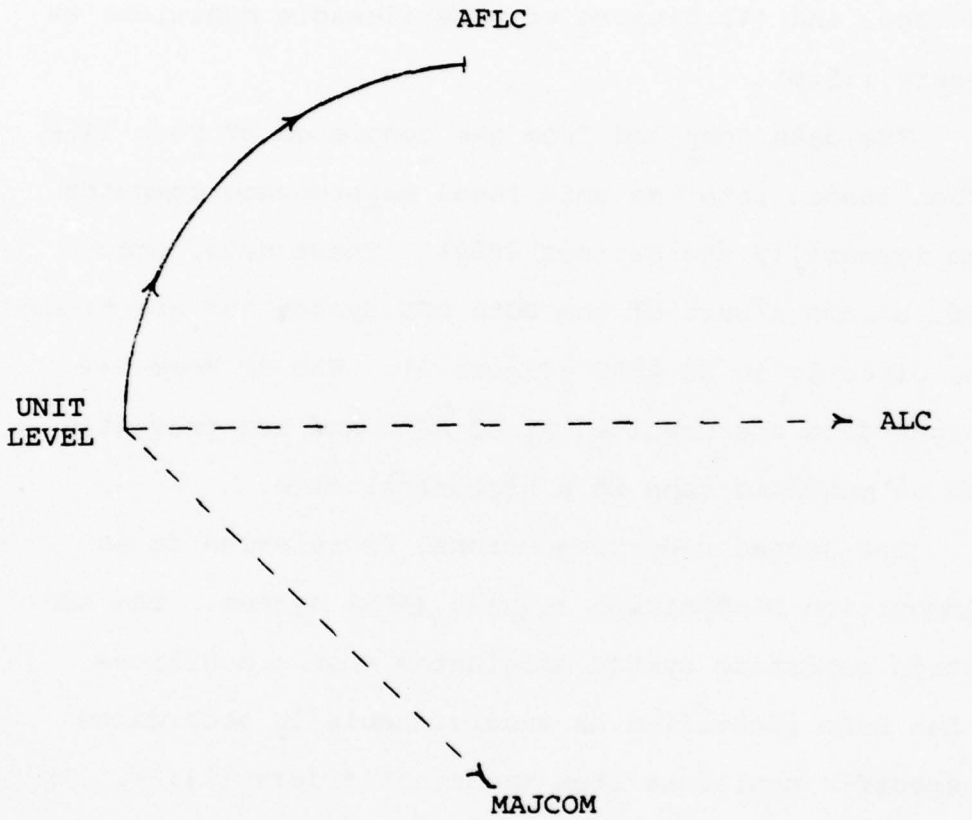

Fig. 1. D056 Maintenance Data Collection

for a 3-cent item. He is authorized by regulation to dispose of the item locally if it does not exceed $100. He would, however, submit an ADR if the number of unserviceable items sampled exceeded the 5 percent limit specified in the technical order (14:5).

The ADR is manually prepared and submitted to the Ogden Air Logistics Center for action (Figure 1). The munitions engineers and technicians at the Ogden Air Logistics Center analyze the information listed on the ADR form and provide disposition instructions to the unit level technician for completion. The disposition takes the form of either (1) destroy the unserviceable items, (2) ship the items to Ogden for further analysis, (3) return the item to serviceable condition, (4) suspend use of all items in the same lot number, or (5) use for training only. These disposition instructions are normally provided to the interested major command as well as the unit. As indicated above, the munitions data are generated from the unit level munitions activity. The data, however, are transmitted through two separate data systems. IG reports indicate the DO56 and the ADR data systems are not providing the information necessary for conducting the Air Force Product Assurance Program in their present form (10:3-1). The data transmitted to Ogden through the ADR system reflect only those munitions items that failed to withstand the inspection criteria identified in the specific item technical

order (8:2). The ADR data are generated after the situation has occurred. Thus, there is no information concerning potential problems submitted through the ADR system. The DO56 data are currently not being used at all (2).

The DO56 MDC system is only a vehicle for transmitting data. We must somehow transform that data into meaningful information. To understand that transformation, an overview of management information, systems theory, and information systems is necessary.

Importance of Information

In today's environment there is an ever-increasing dependence of managers on information. Often we hear managers complain that there is not enough information to get the job done. What the manager may have is not a problem with the quantity but more with the quality of information he is receiving. No one in the organization has taken the time or trouble to determine what kind of information is needed and what information system will best provide that needed information. It is not a lack of data that managers must overcome but finding enough of the right kind of information that will assist them in determining objectives, analyzing alternatives, reaching decisions, forecasting problems, and evaluating results with regard to established objectives.

As a manager of specific munitions items, the munitions technician at Ogden ALC is also dependent on information. The DO56 in its present form provides large amounts of data but unfortunately the enormous amount of normal operations data may be masking important information. By determining what types of information the technician requires, a computer editing program can be developed to filter out the noise of unneeded data and give the technician only the information he needs.

Systems Defined

A system may be defined as an ordered set of components joined to form a unified whole. For example, an automobile is made of a motor, electronic parts, wiring, cables, valves, plugs, wheels, levers, and metal frames all put together to provide a method of transportation. If you go to any junkyard you can observe all these parts in homogeneous piles--a pile of motors here and a stack of frames in the back. These parts, however, are not a system until they are assembled and function together to provide transportation. This example leads one to believe there is more to a system than just the unification of parts (18:22).

Specifically defined, "a system is defined as some on-going process of a set of elements, each of which is functionally and operationally united in the achievement of

an objective [18:23]." This definition points out the three most significant aspects of a system. First, the primary purpose of a system is the achievement of objectives. For example, the car would provide transportation. Second, a system is made up of interconnected and interrelated elements. These elements work together within an overall continuous process. This interrelationship of elements might be looked at as systems within a system. Each of these subsystems performs distinct purposes as a system, but put together they combine into a larger system of systems having a specific purpose. The third characteristic of a system is that it is regulated. Interaction of its elements must be regulated and adjusted as the system functions or the system ceases to be effective (18:23).

The munitions community fits our definition of a system. This community has as its goal the development, acquisition, supply, and maintenance of munitions items needed to meet the requirements of its customers. Some of the interconnected elements which form this system are: the using commands, such as Tactical Air Command and Strategic Air Command, who determine requirements; the Item Managers at the ALC, who are responsible for meeting those requirements; and the munitions technicians, who are responsible for seeing that the munitions remain in safe, working order. The control or regulation of this system in the maintenance area lies with the munitions technician at

Ogden ALC. This technician, like any other manager, is dependent on timely, complete, and accurate information to properly control his system.

Information Systems

> A manager gets his information in a variety of ways and forms. Much of it will come piecemeal, from daily conversations and correspondence with subordinates and superiors, through chance meeting with associates, in special study reports, in memos and reports . . . and from other similar sources. While such random, piecemeal information sources are useful they cannot meet the full range of a manager's information requirements. Managers also need some systematic way of obtaining the information needed to make key decisions. Management information systems are the means of systematically structuring the flow of business data to managers [5:2].

In order for an information system to be effective, it must display the three major features required of a system. First, the information system must promote the objectives of the organization. The information supplied by the system must be user oriented. Second, the information system must consist of interconnected and interrelated information processing activities. In an organization some common information processing activities such as payroll, general ledgers, sales, and inventory should be interfaced to produce the information required by management. Third, the information system must provide for the management of the system. The reports generated by the information system must be reviewed and regulated by

management in order for the reports to fill the needs of management (18:24).

The DO56 MDC system is the information system to be investigated in this research. The munitions community was not consulted in the development of the DO56 (2). It is our belief that the DO56 MDC system violates several requirements of an information system. For example, the malfunction codes used for discrepancies are aircraft oriented and are at times inadequate to describe munitions-related problems. AFM 300-4, Vol. XI, defines malfunction code as a code which "indicates how or why a piece of equipment malfunctioned [12:6]." There is one malfunction code for mild to moderate corrosion. One code for this wide range of corrosion may be sufficient for equipment or even bomb fins. Rust in the fuse well of a bomb, however, is very critical and the one code does not give the technician the information clarity he requires.

The final information system requirement violated by the DO56 is its inability to provide for management of the system. Presently, there is no reformating or analysis performed with these data. No agency looks at these data to insure their accuracy and completeness or insures that these data fill the needs of the managers required to use the system to obtain information (2).

In the past there have been criticisms regarding information systems. These criticisms are commonly focused

on the type of information, the timeliness of the information, and the management of the information system. Looking at the criticisms will help in understanding the difficulty of obtaining an effective information system (18:24).

Criticisms of Information Systems

The first criticism of information systems is the useless information generated by them. The generation of useless information is generally caused by the influence of the availability of data and not by the genuine needs of management. Additionally, the design of the information system may not have considered the format of the information needed by the managers. A well-defined statement of need and use of information by management is necessary to insure the user receives the information required. Second, too much paperwork is commonly expressed when discussing computerized information. The ideas of "need to know" and "exception reporting" probably were not pursued. Selectivity is a must when collecting, storing, and retrieving information to meet management's needs. Third, late reports is another common criticism of information systems. Late reports can sometimes be attributed to inadequacy of hardware and equipment malfunction. Most often, however, it is the design of the system that is lacking. Management must insure that the design of the information system takes into

consideration management's needs for information with regard to frequency as well as volume and quality (18:25-26).

The DO56 also suffers from the above criticisms. Figure 2 is an extract of the munitions MDC data in its current format. Even with a special template to aid in reading the data, munitions technicians at Ogden ALC have found reading the printout very difficult and too time consuming (3). There is no editing performed on the data to separate the normal maintenance activities from the important discrepancy findings. This lack of exception reporting creates "noise" in the form of extra data lines on the report which may hide important information. The final criticism is the age of the MDC information when it becomes available to the manager.

By the time an MDC data printout gets to the manager, the information is forty-five to sixty days old. Due to the nature of the DO56 system, these forty-five to sixty days are needed to compile the information at various collection points and forward the compiled data to HQ AFLC where it is again compiled and finally run (17).

The DO56 contains information on all equipment maintenance performed in the Air Force. The system is geared to be run once a month and produce all the MDC reports needed by the Air Force at that time. It is not geared to operate in an interactive mode (17). We requested a special printout of the munitions MDC data and

```
1430653R330G01      L84D6L4321ARSA8086 ZZ9SOCY38301072509202LXE ZOR    08612099999HDZ 1
1430653R330G01      L84D6L4321ARSA8086 ZZ9SOFY38300142516002LXE ZOR    08612099999HDZ 1
1430701R629G01      L70D6L4321ARSA8086 ZZ9SOXY79901170017302LXE ZOR99908612229999HDZ 6
1430703R610G01      L22D8L4321ARSA8087 ZZ99OAY38101070011452LXE ZOR    08712099999HDZ 1
1430753098110       S84D2L4321ARSA8087 ZZ9SOAY16901160C20002LXE ZOR    08712299999HDZ 1
1430753098210       L22D6L4321ARSA8082 ZZ9SOFY58300160023302LXE ZOR    08712339999HDZ 1
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1430653R547G01      L22BGL4322ARSA8083 ZZ990XY179901160024002LXE ZOR99908312959999HDZ 6
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BA001356                 Y6520SJEB8079 04110      00070C07301LXE ZOY    0790210R356GUB 0
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13251380901              5523DAYWA8088 CABAOZQ17C0063OC1230 4LXE ZOR    11501119999HEY 1
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Fig. 2. Original DO56 Output

it took two weeks to receive the printout. A two-week wait for sixty-day-old information is not the kind of support the technician needs.

In this chapter we have given a brief history and description of how the DO56 MDC system is designed to supply maintenance information to the munitions technician to help him manage his particular system. The DO56 is designed to be an information system but, due to shortcomings such as lack of exception reporting, poor format, age of data, and lack of quick inquiry capability, the DO56 is not being used by the munitions community. The following chapter will give our methodology for analyzing the ability of the DO56 MDC system to aid the munitions community.

CHAPTER III

METHODOLOGY

Areas of Information

The first step in proceeding with this research study is to determine what information is necessary to conduct the Product Assurance Program for the Air Force. As stated earlier, Ogden ALC has been tasked to conduct the program with HQ AFLC retaining the ultimate responsibility for the Product Assurance Program.

HQ Air Force Logistics Command/Directorate of Equipment, Munitions, and Electronics (AFLC/LOW) personnel were contacted for general information areas they consider to be necessary in *monitoring* the Product Assurance Program. Additionally Ogden Air Logistics Center, Munitions, Engineering and Technical Services Division (ALC/MMWR) technicians were contacted for specific information areas they deemed important in *conducting* the Product Assurance Program.

The DO56 MDC system is only one input to the Product Assurance Program. To investigate all sources of information or how these pieces of information should be integrated is beyond the scope of this research. This research study is in the area of munition data and the DO56

system. Thus our first step in this study was to determine what information generated by the unit level munitions technician is essential to the Air Force Product Assurance Program.

The munitions personnel at HQ AFLC and Ogden ALC were contacted a second time and a list of the information areas was determined. This list of information areas was developed considering the ability of the unit level munitions technician to generate information in that area.

The first information needed is which base generated the maintenance activity. Since munitions are very sensitive to temperature changes and general climate conditions, knowing the environment to which the munitions item has been subjected is important to the Ogden munitions technician. For example, munitions located at Luke AFB, Arizona, are influenced by very different climatic conditions than munitions stored at Clark AFB, Philippines. Corrosion found on bombs at Clark due to its wet climate might be expected where corrosion on bombs at Luke may be indicative of a more serious Air Force-wide problem. These environmental conditions are considered vital in determining the significance of reported munitions maintenance (3).

The next area considered important is a time reference. Munitions items are scheduled for inspections during a specific quarter. Technical Order 11A-1-10 establishes the months when specific munitions items are to be inspected.

For example, small arms such as .38 caliber bullets are to be inspected January through March. Bombs are inspected August through September. By knowing the date of the maintenance activity, the Ogden munitions technician is able to determine if the maintenance action is in conjunction with a scheduled inspection or if the maintenance activity is external to the normal inspection cycle. Knowing the date and the location will assist the Ogden technician in understanding the changes in the volume of activity at the unit level. For example, northern bases conduct approximately 95 percent of small arms qualification training during the summer months. The technician at Ogden would expect an increase in activity on small arms items during the summer months from a northern base (3).

Following the where and when information, the technicians are interested in what munitions items are involved. This information allows the Ogden technician to evaluate the situation based on the criticality of the item. A munitions item may be determined critical by the nature of the item or its use. Ejection seat munitions are critical because of their direct link with safety and human life, whereas a missile-related rocket motor is critical because of its production complexity and high cost. Knowing the item involved allows the Ogden munitions technician to explore other related areas such as replacement costs and production lead time. The specific item can be identified

in two places on the MDC data output. The first location is the Component Part Number which can be the Federal Stock Number (FSN) or the part number if no FSN has been assigned. The second is the World Unit Code (WUC) which is a five-character alpha-numeric code for specific components or complete assemblies. The applicable WUC can be found in T.O. 11-A-1-06.

The next necessary area of information is centered around the maintenance action involved. The technician at Ogden is interested in the various maintenance activities being conducted on the munitions items. Included in these activities are inspection, bench check, calibration, and repair, to name a few.

Closely associated with the maintenance actions is the information concerning the work center involved in the maintenance action. The work centers for non-nuclear munitions focus on two primary maintenance branches. The Storage and Handling Branch is responsible for the storage and delivery of the munitions. The Storage and Handling Branch also performs the actual repair and maintenance functions within the munitions organization. The Inspection Branch maintains the data records on the munitions items and conducts all munitions inspections (15:18).

The last area of interest to the Ogden munitions technician is information concerning a deficiency in the stockpile. This information should describe, as accurately

as possible, the deficiency found at the unit level. The technicians at Ogden are concerned with the deficiency involved, the severity of the deficiency, and its magnitude. A deficiency of rust on a bomb takes on additional meaning when the depth of the rust and the number of bombs affected are provided. Examples of possible deficiencies include leaking, dented, corrosion, bent, loose, and broken (12:6).

Data Separation

Now that the factors needed by the Ogden ALC technician have been found, and the data elements containing information on these factors identified, the task remaining is to analyze the DO56 MDC output to see if the needed information is in fact in the system. The data product obtained for the month of August contained over nine thousand lines of data and reflects the large number of actions performed by the Air Force munitions community. The data are output in the order in which they are received and are virtually impossible to analyze in this form. As discussed earlier, the DO56 system was not designed for individual inquiries and requires almost two weeks to produce requested data. To overcome this slow response time a tape extract of the munitions MDC data was produced. This tape enabled the data to be manipulated outside the DO56 system. To perform our data analysis, we focused on several representative munitions items.

The MK-82 500-pound general purpose bomb was selected as one of our representative munitions items. The MK-82 is made up of explosive elements, such as the bomb body, fuses, and delay elements; and nonexplosive elements, such as fins, arming wire, and lugs. These elements that make up the MK-82 are a representative cross-section of the types of elements that comprise the munitions inventory. Each of these elements has a distinct Federal Stock Number (FSN) which enabled us to extract information on these particular items.

All the elements associated with bombs are found in the 1325 Federal Stock Class (FSC). Our first computer manipulation of the data, once the munitions tape had been extracted from the DO56, was to extract the 1325 file. The 1325 FSC contained all our representative items and comprised 3278 of the 9000 munition records for the month of August 1978. Our next step was to put these data through a program which sorted the data according to FSN and then according to base within each FSN. This output in itself was very valuable as will be discussed in Chapter IV. By sorting the data at this time, any further manipulation of data would automatically be sorted by FSN and by base within each FSN.

There are principally two outputs produced at this point. Investigation of the sorted 1325 FSC brought to our attention unusual activity in Part Number 69F30301, the

BDU-33 B/B, 25# Practice Bomb. Further investigation showed a high number of special inspections in which corrosion and missing fasteners were discovered at bases where fighter aircraft were located. A telephone conversation with TAC Munitions Staff Personnel revealed that problems had been discovered with this item and a special inspection had been ordered through T.O. 11A-1-1 (6). A computer program was written to extract this particular item and translate the code into literals which would be easier to read. Figure 3 is an example of the output obtained. Analysis will be discussed in Chapter IV.

The second output is an extract of the munitions parts which make up the MK-82, 500-pound bomb (Figure 4). We created a computer program which extracted these particular records from our 1325 FSC file and wrote them to a separate file. Analysis of this output is also contained in Chapter IV.

It is important to remember that these outputs all come from the same coded data produced by the D056. The data can be sorted or output according to any field contained in the data. For instance, we extracted all the munitions activity at Shaw AFB to demonstrate the capability to extract according to base instead of FSN. The format can also be tailored to the user's needs. The output can be printed in literals (Figure 3) instead of code and

AUGUST 1978

MONTHLY D056 MDC REPORT

FSC 1325 PART NO. 69F30301

BASE	COMMAND	MALF	WK UNIT CODE	MAINT ACTION	WHEN DIS
AVIANO ITALY	USAFE				
AVIANO ITALY	USAFE				
AVIANO ITALY	USAFE				
BERGSTROM	TAC				
BUCKLEY COL	ANG				
BUCKLEY COL	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
BYRD FLD VA	ANG				
CAPITAL ANG ILL	ANG	NO DEFECT	25# PRAC BODY	ASSEMBLE	SCHED INSP
CAPITAL ANG ILL	ANG	NO DEFECT	25# PRAC BODY	ASSEMBLE	SCHED INSP
CAPITAL ANG ILL	ANG	NO DEFECT	25# PRAC BODY	ASSEMBLE	SCHED INSP
CAPITAL ANG ILL	ANG	NO DEFECT	25# PRAC BODY	ASSEMBLE	SCHED INSP
CLARK PHILI	PACAF	NO DEFECT	20MM PRAC CART	ASSEMBLE	SCHED INSP
CLARK PHILI	PACAF	NO DEFECT	20MM PRAC CART	ASSEMBLE	SCHED INSP
CLARK PHILI	PACAF	NO DEFECT	25# PRAC BODY	ASSEMBLE	UNSCHED INSP
CLARK PHILI	PACAF	NO DEFECT	25# PRAC BODY	ASSEMBLE	UNSCHED INSP
CLARK PHILI	PACAF	NO DEFECT	25# PRAC BODY	DISASSEMBLE	SCHED INSP
CLARK PHILI	PACAF				
CLARK PHILI	PACAF				

Fig. 3. BDU 33

LISTING FOR MK 82 500# BOMB

```
13251380901  H5221SYWA8178 04141     01073012303AEDYOD  17824419999
13251380901  H5221SYWA8205 04141     01143016302AEDYOD  20224419999
13251380901  15250AYWA8195 03113     01140017003ASHEOD  194A9019999
13251380901  DW250AYWA8201 03113     04074508202BJHZOT  20137469999
13251380901  DW250AYWA8200 03113     01084511302BJHZOT  20037469999
13251380901  F5250SYWA8198 0411A     09080012002BSGXOD  19873019999
13251380901  V5200SYWA8194 0411E     00123013452CVVM4Z  19401629999
13251380901  2W251AYWA8198 03113     01123015004CZQZOT  19865089999
13251380901  2W251AYWA8200 03113     01080009003CZQZOT  20065059999
13251380901  2W251AYWA8198 03113     01080011004CZQZOT  19865079999
13251380901  2W251AYWA8199 03113     01123013453CZQZOT  19965069999
13251380901  2W251AYWA8199 03113     01080010303CZQZOT  19965079999
13251380901  AW230AYWA8186 CABAOZM17002073011305DVLKOR  17025399999
13251380901  AW230AYWA8186 CABAOZM17002130017005DVLKOR  17025399999
13251380901  AW230AYWA8172 DKDROFM17000130017006DVLKOR  17025399999
13251380901  AW230AYWA8172 DKDROFM17000073011306DVLKOR  17025399999
13251380901  AW230AYWA8181 CABOONM79915130017003DVLKOR  18126289999
13251380901  AW230AYWA8178 CABOONM79980130017002DVLKOR  17826289999
13251380901  AW230AYWA8182 CHCOONM79902073011302DVLKOR  17025399999
13251380901  AW230AYWA8181 CABOONM79920073013005DVLKOR  18126289999
13251380901  AW230AYWA8182 CHCOONM79902130017002DVLKOR  17025399999
13251380901  AW230AYWA8192 CHCAONM79901130017006DVLKOR  19226289999
13251380901  AW230AYWA8192 CHCAONM79901073011456DVLKOR  19226289999
13251380901  AW230AYWA8198 CHCAONM79999070011306DVLKOR  19226289999
13251380901  AW230AYWA8198 CHCAONM79999130017006DVLKOR  19226289999
13251380901  AW230AYWA8193 CHCAONM79999130017006DVLKOR  19326289999
13251380901  AW230AYWA8193 CHCAONM79999070011456DVLKOR  19326289999
13251380901  AW230AYWA8194 CHCAONM79915070007305DVLKOR  19326289999
13251380901  2W250AYWA8194 03113     01071509153FBNVOT  19454349999
13251380901  P5250AYWA8193 03113     75090010002FSPMOH  19346059999
13251380901  A5231BYWA8201 CABOOZF17001130016006FTFAOH  20011269999
13251380901  A5231BYWA8191 CABOOZF17001070011304FTFAOH  18411529999
```

Fig. 4. MK 82

unnecessary data can be eliminated from the output if not needed by the user.

We have demonstrated the ability to manipulate and output the DO56 MDC data to facilitate the analysis of the information contained in this system. The next chapter is our analysis of these data and identification of significant areas of interest relating to the DO56 munitions data system.

CHAPTER IV

FINDINGS

Once the munitions data had been extracted from the August D056 tapes at AFLC, an analysis of exactly what information was contained in the monthly reports became necessary. Basic knowledge of the coding structure format for the munitions data is located in various Air Force sources. There are several key references, however, which proved invaluable in identifying and interpreting the specific codes within the D056 system. For example, AFM 66-1 provided the general background for the reporting of maintenance actions. T.O. 11A-1-06 and T.O. 00-20-2, however, provided the specific information regarding what codes and under what conditions munitions maintenance data are to be reported.

Data Sort

Our first step was to investigate the 1325 Federal Stock Class (FSC) data which had been sorted according to Federal Stock Number (FSN). This output is very valuable for it serves as a source listing for all munitions activity within the FSC. If the munitions community wishes to know the level of activity associated with a specific FSN they are able to turn quickly to the collected data without

having to go through the entire 9,000 records and manually extract the appropriate lines. Investigation of the data in this format can also quickly identify FSNs with unusually heavy activity or a maintenance activity trend. For example, our investigation of the August 1978 data showed unusually heavy volume in part/number 69F30301, BDU-33, 25 pound practice bomb. As discussed in Chapter III, we later learned that there had been a problem with this item and the activity was in response to a directed inspection by OO-ALC munitions technicians.

Missing Codes

The first area of concern centered around the how malfunction code. We originally identified the how malfunction code as the most significant data element to be analyzed. The first extractions were generated by gathering only those munitions records that contained how malfunction codes. However, much of the munitions records filed into the DO56 system do not contain how malfunction codes. For example, a file was created from the August munitions data for the BDU33 practice bomb. This 25-pound practice bomb is used to simulate the explosive-filled 500-pound MK82. Information regarding munitions usage rates indicates the BDU33 would be a very active munitions item for the month of August (6). The BDU33 file reflected 404 munitions maintenance transactions on this item. The

excerpt from the BDU33 file, Figure 3, contains records which have no how malfunction code. In fact, of the 404 records read into the BDU33 file, only 191 records contained a how malfunction code. Additional interviews with munitions technicians indicate that current reporting philosophy is causing the missing how malfunction codes. This philosophy concerns the current use of the Work Unit Code (WUC) "support general." When an inspection or maintenance action has not been specifically requested by the Ogden Air Logistics Center (OO-ALC), the base level munitions technicians are authorized to use the support general WUC. The BDU33 file excerpt, Figure 3, indicates that not only the how malfunction codes are missing but also the WUC, maintenance action codes, and when discovered codes are missing as well. The current DO56 system does not capture these data fields whenever the support general WUC is used (8).

The Work Unit Code was found to actually be the key element in identifying the meaningful information being expressed by the unit level munitions technicians. The coding structure allows for specific identification of the munitions item being reported. It is the code that drives what how malfunction code and what maintenance action code to use. When purposefully selected, the specific WUC can serve as the basis to express the transaction documented on the AF Form 349. With an increasing use of the "support general" WUC, the amount of DO56 munitions maintenance data

being lost is also increasing (4). The use of the "support general" WUC prohibits the AFLC computers from retrieving much of the conventional munitions data. Approximately half of the munitions maintenance records currently listed in the AFLC DO56 system do not contain meaningful munitions maintenance data codes. This lack of information has made the munitions technician at OO-ALC reluctant to obtain the DO56 munitions data from AFLC (8).

"On" versus "Off" Equipment

Current munitions DO56 coding practices do not clearly communicate the maintenance action the unit level munitions maintenance technician is attempting to convey. Munitions maintenance personnel are using the same coding philosophy for munitions that aircraft maintenance personnel are using to document "on" equipment for aircraft. "On" equipment are those items considered to be an integral part of the end item. When these items are removed from the end item for repair, the "on" equipment is documented as being associated with its end item. The DO56 MDC coding system permits the association of aircraft and their related "on" equipment items (15). Munitions components are not directly associated with munitions end items the same way "on" equipment are (4). For example, the M904 fuze is a nose fuze for a general purpose gravity bomb. This fuze can be used on the MK-82 500-pound series bomb, the MK-81 250-pound

bomb, M117 750-pound bomb, MK-83 1000-pound bomb, or the BLU-82/B 15000-pound bomb. The munitions technician should code munitions items as "on" equipment when they are in fact assembled or combined to form a weapon system or complete round. Confusion can result from munitions items being coded as "on" equipment rather than unassociated end items. To illustrate, an extract of all DO56 munitions maintenance transactions for MK-82 500-pound bombs and related components was processed from the August 1978 AFLC DO56 system file. Figure 5 is an excerpt of that listing. Line number 180 of Figure 5 reflects a munitions transaction generated from Clark AB. The Federal Stock Number (FSN) listed is 13251380901. This FSN is the number for a MK-82 500-pound bomb. The Work Unit Code (WUC) shown is "DKDRO" which is the code for an M905 tail fuze (13:DK001). T.O. 11-A-1-06 directs that when one uses the WUC of "DKDRO" the FSN should be 13258839354. Additionally, the how mal code of "170" indicates a mild to moderate corrosion problem exists. The when discovered code is used to describe at what time a discrepancy was discovered. The when discovered code "M" indicates the corrosion problem was discovered during a scheduled (normal) inspection. The action taken code describes what maintenance work was done. The action taken code "F" indicates the item was disassembled, cleaned, and reassembled (13:IV-005). The confusion arises for the munitions technician at Ogden when he tries to determine

```
0010                    LISTING FOR MK 82   500# BOMB
0020
0030
0040 1325'380901'       H5221'SYWA8178 04141      0'07301'2303AEDYOD    17824419999
0050 1325'380901'       H5221'SYWA8205 04141      011430'6302AEDYOD     20224419999
0060 1325'380901'       15250AYWA8195 03113       011400'7003ASHEOD     194A9019999
0070 1325'380901'       DW250AYWA8201 03113       04074508202BJHZOT     20137469999
0080 1325'380901'       DW250AYWA8200 03113       0'08451'302BJHZOT     20037469999
0090 1325'380901'       F5250SYWA8198 0411A       0908001'2002BSGXOD    19873019999
0100 1325'380901'       V5200SYWA8194 0411E       00'230'3452CVVM4Z     1940'629999
0110 1325'380901'       2W251'AYWA8198 03113      0''230'5004CZQZOT     19865089999
0120 1325'380901'       2W251'AYWA8200 03113      0'080009003CZQZOT     20065059999
0130 1325'380901'       2W251'AYWA8198 03113      0'0800''1004CZQZOT    19865079999
0140 1325'380901'       2W251'AYWA8199 03113      0''230'3453CZQZOT     19965069999
0150 1325'380901'       2W251'AYWA8199 03113      0'0800'0303CZQZOT     19965079999
0160 1325'380901'       AW230AYWA8186 CABAOZM1700207301'305DVLKOR      17025399999
0170 1325'380901'       AW230AYWA8186 CABAOZM17002'300'7005DVLKOR      17025399999
0180 1325'380901'       AW230AYWA8172 DKDROFM170001300'7006DVLKOR      17025399999
0190 1325'380901'       AW230AYWA8172 DKDROFM'700007301'306DVLKOR      17025399999
0200 1325'380901'       AW230AYWA8181 CABOONM799'51300'7003DVLKOR      18126289999
0210 1325'380901'       AW230AYWA8178 CABOONM799801300'7002DVLKOR      17826289999
```

Fig. 5. MK 82 Listing

which item the unit level munitions technician is addressing. The DO56 data could be conveying that during a normal inspection of a 500-pound MK-82 bomb, M905 tail fuze was found to have rust. The technician took the fuze out of the bomb, cleaned it and placed the fuze back into the bomb. However, the data could also be indicating that during a scheduled inspection of M905 tail fuzes one was found to have rust. The technician took the fuze out of the container, disassembled it, cleaned the fuze, reassembled the fuze and placed it back into its container. The question the Ogden technician must answer is whether the fuze is associated with the bomb or whether the fuze is being stored as a separate end item (3).

Storage, limitations, explosive safety restrictions and munitions compatibility storage procedures have supported the practice of storing munition components separately (9). In today's munitions storage environment, the OO-ALC technicians are considering munitions items to be "Off" equipment or individual end items not assembled into complete rounds. Therefore, the information conveyed by line 180 of Figure 5 is received by Ogden technicians as a corrosion problem involving the end item, an M905 tail fuze. The fuze is assumed to be stored as a separate end item and not assembled into a MK-82 bomb (4). The shortcoming with this assumption is that the assumption is based on speculation. The current DO56 system coding guidance

allows the unit level munitions technician to code the munitions data as "On" or "Off" equipment. This flexibility in coding makes interpretation of the data by the Ogden munitions technician extremely difficult (3).

Local Codes

When the D056 munitions maintenance data are transmitted from the unit level munitions activity to AFLC, the data contain local codes that have meaning only to the local unit. For example, Figure 6 reflects the code titled, Owning Work Center. This code is a locally assigned code that identifies the maintenance activity recording the AF Form 349. Since the codes are assigned and managed by the local Deputy Commander for Maintenance, AFLC and OO-ALC have no need to translate these codes. The local codes identified as (1) Time Serial Number, (2) Owning Work Center, (3) Tag Number, (4) Sequence Number and (5) Identification Number, occupy twenty-one card columns of space that possibly could be better used to provide more meaningful information to the OO-ALC technician and to the AFLC munitions management personnel.

Wrong Federal Stock Number

Figure 3 is an excerpt of the BDU-33 file that was translated into literals. This listing should contain only maintenance information for the BDU-33 practice bomb. However, the two underscored lines reflect a work unit code for

	FSN	Time Serial Number	Owning Work Center			Units		Tag Number		Sequence Number	Identification Number
0130	13251380901		2W251	AYWA8198	03113	01	080011004CZQZ0T		198	6507	9999

Fig. 6. DO56 Data--Single Record

the twenty-millimeter practice round. Within the DO56 munitions data there are additional examples of Federal Stock Numbers and Work Unit Codes not being compatible. Although these errors originated at the unit level, our real concern lies in the inability of the current DO56 munitions system to detect these compatibility errors and allow the data to be entered into the DO56 Maintenance Data System master file.

Units

In order for the OO-ALC munitions technician to manage the Product Assurance Program he must be aware of the magnitude of the maintenance action and the impact that maintenance action is having on the munitions stock pile. For example, if the OO-ALC munitions technician received indications that a particular fuze is being rejected because it is failing a particular functional check, the munitions technician at OO-ALC would certainly want to know how many fuzes were affected.

One code currently listed in the DO56 munitions format entitled "Units" could serve to identify the number of munitions assets involved in the reported maintenance action. This code "Unit" is now loosely defined as the number of units specified by the work order; i.e., AF Form 349. The difficulty with the present definition is the lack of consistency. When the AF Form 349 is prepared

locally, the crew doing the maintenance action is knowledgeable as to how many items were processed. The OO-ALC technician, when he sees a 01 in the units space, Line Number 130 (Figure 6), does not know whether the unit level technicians are referring to one each, one box, one pallet load, or one storage location. Without a more clearly defined units code, the OO-ALC munitions technician can only speculate the number of munitions items involved in a particular maintenance action.

Levels of Detail

The munitions community will use the DO56 MDC data for two distinctively different purposes. The munitions personnel at the OO-ALC are technicians and are responsible for conducting the Munitions Product Assurance Program. The information they seek should be specific, highly detailed and timely. The coding should be simple, technically oriented and in compliance with munitions technical orders. This information should convey if there is a problem, who has the problem and how big the problem is. The munitions personnel at AFLC are responsible for monitoring the Product Assurance Program. The information they seek is less technical, general in nature, and provided on an as-required basis. The munitions staff personnel use the information to determine if scheduled inspections were conducted when required and if directed maintenance actions

were completed in a timely manner. The current DO56 munitions data system is capable of providing the munitions information to both OO-ALC and AFLC in the levels of detail required. Formatting variations, literal translations and sorting operations serve to enhance the DO56 munitions maintenance data system.

CHAPTER V

RECOMMENDATIONS AND CONCLUSIONS

The findings presented in Chapter IV, and the recommendations and conclusions described in this chapter, were provided to the AFLC munitions staff personnel. The recommendations are being used to guide the munitions staff as they begin refining the DO56 Maintenance Data Collection System for munitions. These conclusions address future considerations and uses of the munitions maintenance information as it becomes a more significant input to the Air Force Munitions Product Assurance Program.

Data Sort

As discussed in Chapter IV, the Federal Stock Number (FSN) sorting of the Maintenance Data Collection (MDC) data was found to be a very useful system output. Our recommendation for AFLC/LOW is to receive, as a minimum, the FSN listing of DO56 data once a quarter. These quarterly outputs would coincide with the inspection intervals established in T.O. 11A-1-10 and enable AFLC to monitor a complete inspection cycle. By viewing the complete cycle in one output the maintenance discrepancy trends should be easier to identify due to the increased number of data points. This quarterly output would also serve as a

data source document for answers to inquiries on munitions maintenance activity. For example, during our research, AFLC/LOW was asked by a Logistics Project Officer at Eglin AFB if maintenance data were being collected on his particular munitions item. By referring to the sorted data, AFLC/LOW easily found the appropriate lines of data and verified to the Project Officer that his item was being reported by the D056 MDC system.

Missing Codes

As mentioned in Chapter IV, the use of Support General Work Unit Codes is causing the omission of valuable munitions maintenance data. We recommend that the munitions community, led by AFLC/LOW, establish specific guidelines on the use of the Support General code, and monitor the MDC output to insure compliance with the original philosophy that established the Support General Codes for munitions in T.O. 11A-1-06.

Involvement of unit level munitions technicians in establishing the new guidelines is also recommended. Historically the field units have focused on inputting the maintenance data into the MDC system but had little understanding of the intended use of the data. Through involvement, the units level technicians will gain an understanding as to the value of the munitions information they are creating. Additionally, the guidance must convey

to the field units that the Support General Codes are causing the loss of valuable munitions information. Support General Work Unit Codes should not be used as a catch-all WUC, but should be used only when a specific requirement authorized by a munitions coding policy is identified.

"On" versus "Off" Equipment

The current policy of coding munitions actions as "on" equipment instead of "off" equipment can cause confusion and misunderstanding. The Ogden ALC munitions technicians along with the AFLC munitions staff must be able to determine which specific item is being addressed in a line of data. We recommend the munitions community establish a commonly understood coding philosophy and policy for the DO56 MDC system. This policy should insure a clear understanding of what coding structure to use for input and how that input is to be interpreted once the data have been collected by the DO56 system.

Local Codes

As presented in Chapter IV, there are several data codes that are submitted to the DO56 system that are for unit level purposes only. We recommend these codes be investigated by the munitions community as possible candidates for deletion. Deletion of these codes would make space available for the submission of more meaningful

information. Also, we recommend that munitions personnel investigate the possibility of including the munitions lot number as part of the DO56 system. The munitions lot number is a standardized coding system that identifies a specific munitions item, the manufacturer, and date of manufacture. Munitions are produced in batches or lots. Lot identification and integrity are maintained through the lot number system.

Munition items produced in the same lot generally have the same characteristics. For example, if a munitions item for a particular lot at one base has been found to be defective, chances are, items from the same lot at other bases are defective. If the OO-ALC technician can pinpoint a trend in a specific lot, he can alert those munitions units owning that lot and correct or suspend those items. The standardized lot numbering system identified in T.O. 11A-1-10 can be incorporated into the DO56 system.

Wrong Stock Number

In Chapter IV we provided an example of 20 millimeter munitions being reported as a BDU 33 practice bomb. We recommend such incompatible records be prevented from being accepted into the DO56 system. We further recommend the munitions community investigate establishing an edit capability for the munitions portion of the DO56 MDC system.

Units

Munitions personnel at AFLC and OO-ALC should know the number of munitions items being reported. We recommend that the "units" code be clearly and specifically defined. This definition should allow for no misunderstanding as to the number of munitions items involved. Consideration should be given to increasing the size of the units field to allow entry of the total number of deficient items to be reported. This definition, once agreed upon, will provide a consistent data element that will enhance the Munitions Product Assurance Program.

Conclusions

This research has shown the DO56 to contain information that is valuable to both AFLC/LOW and the technicians at Ogden ALC. The system, as it stands today with the problems discussed in Chapter IV, can still be of use if the data are properly sorted and the output formatted according to the needs of the user. If the recommendations suggested earlier in this chapter are implemented, the DO56 MDC system can become a major input to the Product Assurance Program as it was originally intended. Under the present system where no DO56 data are used, the technician at OO-ALC reacts to a problem only after it is identified in the field. The technician is constantly "putting out fires" and does not receive the trend information from

the D056 which could enable him to anticipate some of these problems.

The actual implementation of these recommendations should be relatively simple. The D056 system for munitions reporting is already in being and our recommendations do not change the basic procedures already established. Through better definition and guidance, the input made at the local level can be improved and made to better reflect the actual status of munitions in the field. This increased effort by the munitions units, however, must be rewarded through increased OO-ALC technical guidance and AFLC/LOW management support for maximum success of the program. Figure 7 depicts the suggested full cycle flow of feedback information.

The scope of this research has been limited to the use of the D056 data in support of the Munitions Product Assurance Program. There are other areas, however, where these data may be used and the munitions community needs to be aware of the importance of accurate and complete data. Acquisition of munitions is one such area where maintenance data should be used. AFR 800-11, Life Cycle Management Program, states:

> Air Force personnel will consider the full impact of life cycle costs in decisions associated with selection, design, development, procurement, production, modification, repair, or use of defense materiel [11:1-2].

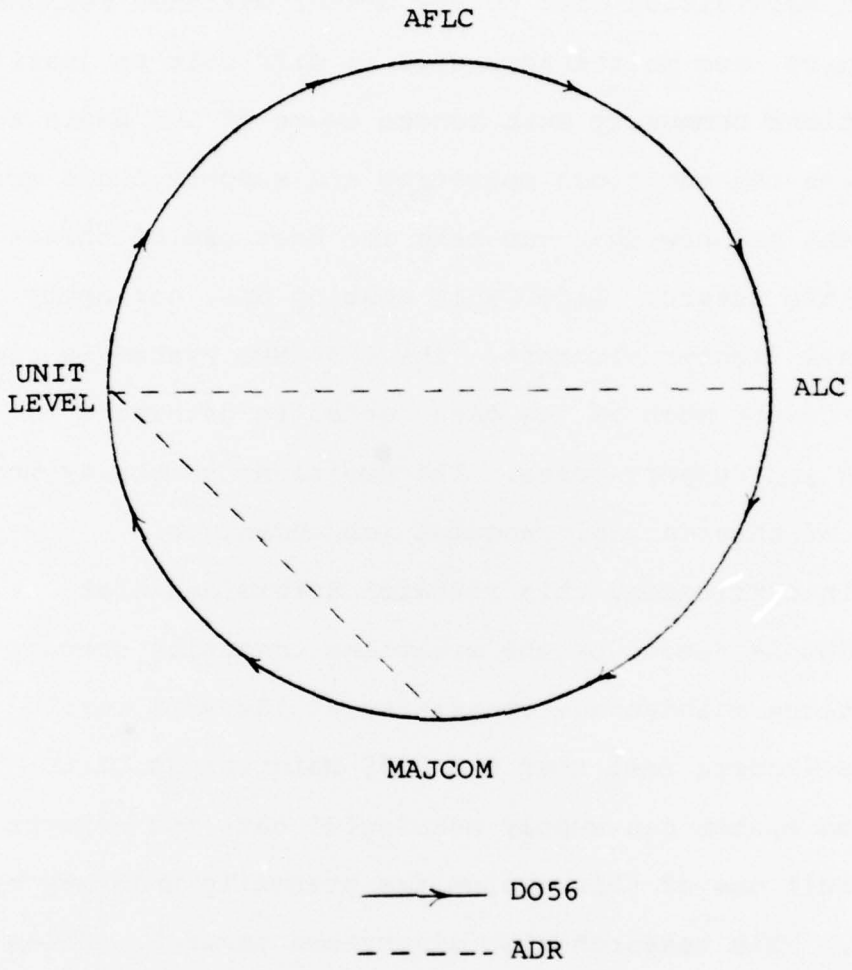

Fig. 7. Full Cycle MDC

Our only complete source of data on the maintenance actions taken and manhours spent on a particular munitions item is the DO56 Maintenance Data Collection System (MDC). Without the hard evidence of these data, the tradeoff of increased acquisition cost to buy better designed weapons that require less maintenance will be difficult to justify. The munitions community must become aware of and begin to track where the munitions operating and support funds are being spent and how they can make the best use of these funds in the future. Life Cycle Costing does not apply to only new fighter aircraft. The DO56 MDC system is the only source for much of the data needed to determine operating and support costs. The munitions community should make use of this valuable acquisition technique.

In conclusion, this research determined what information is needed by the munitions community concerning the munitions maintenance activities at the unit level. These researchers feel that the DO56 Maintenance Data Collection system can supply meaningful data and efforts to make full use of this system are presently underway by AFLC/LOW. This research also discovered several problem areas and recommended solutions which could greatly enhance the clarity and usefulness of the munitions maintenance data. This improved data can be of great help not only to the Product Assurance Program, but to other areas such as life cycle costing in the acquisition area. The munitions

community needs to realize that this computerized data system, which is costing them both monies and manpower, can be of great analytical value if applied to an active Air Force Product Assurance Program.

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